Paper Code & Title: **S-101- Matrix Theory & Complex Analysis**

Credits Point**: 4**

L	T	P
3	1	0

Unit	Contents	Contact Hours
I	Matrix Theory: Linear transformation, Matrix representation of linear transformation, Similar transformation, Echelon matrix, Singular & Non-singular transformation, rank of matrix, Diagonalisation of matrices, Characteristics roots & Characteristics vectors, Special Theorem, Quadratic form & their reductions. Simultaneous reduction of two quadratic forms. Cayley Hamilton theorem, Trace & Transpose of Linear transformation, Jacobian's Lemma, Sylester Law of Hermition transformation, Unitary & Normal transformation.	**14**
II	Complex Number: Definition, Modulus, Argument, Geometrical representation, Vector representation, Conjugate Complex number. Analytic Function: Limits, Continuity, Convergence, Differentiality in extended complex plane, The necessary & Sufficient condition for f(z) to be analytic, Regular function, Analytic Function , Cauchy Rieman equations.	**14**
III	Conformal Transformation: Transformation, Conformal transformation, The necessary & Sufficient condition for f(z) to represent. Conformal Mapping, Some elementary transformation. Complex Integration: Definition, Reduction of complex to real integer, Cauchy Fundamental theorem, Cauchy Integral Formula, Poission's Formula, Cauchy Inequality, Liouville's theorem, Power series, Taylor & Laurent 's theorem. Calculus of residues: Residue at Simple Pole, residue at a pole of order greater than unity, residue at infinity, cauchy's residue theorem.	**14**

References:

1. Biswas, S. : Topics in Algebra of Matrix.
2. J.N.Sharma : Fundamental of a complex variable
3. E.T.Copson :Complex Analysis
4. W.Rudin : Real & Complex Analysis
5. R.A.Silverman : Introduction Complex Analysis

Paper Code & Title: **S-102- Probability Theory and Probability Distribution**

Credits Point**: 4**

L	T	P
3	1	0

Unit	Contents	Contact Hours
I	Concept of Probability: Different definition. Classical or Empirical or Statistical definitions of probability, Axiomatic definition of probability, Fundamental rules of probability for composite events, Combinational, Baye's Theorem. Independent of events. Random variables (r.v.). Discrete and Continuous random variables. Probability Distribution of Random variables, Expectation. Properties of Expectation. Moments, Central Moments, Ordinary Moments. Chebyshev's Inequality, Moment's Inequalities involving Beta Coefficients.	**14**
II	Moments Generating Function (m.g.f). Properties of m.g.f., Probability generating function(p.g.f.), Characteristic Function (c,f) of a random Variables, Properties of c.f. , transformation of random Variables, Marginal and Conditional Distributions. Correlation and Regression analysis, Multiple correlation coefficients, Partial correlation coefficient.	**14**
III	Basic Probability Distribution: Uniform Distribution, Poisson Distribution, Geometric Distribution, Negative Binomial and Multinormal Distributions, Rectangular. Normal, Beta, Cauchy, Laplace, Exponentional Distributions and their properties, m.g.f., p.g.f., c.f., and Recurrence relation for Moments and problems based on them.	**14**

References:

1. Goon Gupta & Das Gupta : An Outline of Statistical theory Vol. II
2. Meyers Paul: An Introduction to Probability Theory Vol. I Second Edition
3. Feller W.: An Introduction to Probability Theory Vol. I Second Edition

Paper Code & Title: **S-103- Statistical Methodology**

Credits Point**: 4**

L	**T**	**P**
3	**1**	**0**

Unit	**Contents**	**Contact Hours**
I	Limit Theorem. Central Limit Theorem (C.L.T.), and Lindberg Levy from CLT, Chebyshev's Inequality.	**14**
II	Chi-Square distribution, Chi-Square Goodness of Fit, Application of Chi-Square distribution, Recurrence relation for moments of Chi-Square, Properties of Chi-Square distribution, Students t-distribution, Application of t-distribution, F-distribution, Inter relationship between Chi-Square, t and F-distributions, Properties of F-distribution.	**14**
III	Sampling distribution of Mean and Variance, Sampling distribution of Sample Correlation when population coefficient when population correlation coefficient p (p=0) Equal to zero. Order Statistics, Distribution of $X_{(r)}R^{ui}$ Order distribution of smallest Order Statistics X(1) , Distribution of largest Order Statistics.	**14**

References:

1. Goon Gupta & Das Gupta : An Out Line of Statistical Theory Vol. -- I
2. Spiegel, MA. : Theory and Problems of Probability and Statistical (Schaum's Outline Series)
3. Hogg & Craig : An Introduction to Theory of Statistics
4. Mood and Grabill : An Introduction to Theory of Statistics
5. David : Order Statistics (John Wiley Publication)

Paper Code & Title: **S-104- Measure Theory and Analysis**

Credits Point**: 4**

L	**T**	**P**
3	**1**	**0**

Unit	**Contents**	**Contact Hours**
I	Basic Concept of Sets, measure, Measurable Sets, Lebesgue Measure of a Set , exterior & Interior measure, measurable space, measurable functions, equivalent function, Simple Function,	**14**
II	Lebesgue Measurable functions, Characteristic function, Lebesgue integral of a function ,first mean value theorem, conversions of measure, Uniform Convergence , Reisz Theorem , D.F.Egor's Theorem,	**14**
III	Extension of a measure, Continuous & absolute continuous function, indefinite integral differential function, increasing & decreasing function, function of bounded variation.	**14**

References:

1. Measure theory by P. R. Halmos
2. Measure Theory by K. P. Gupta

Paper Code & Title: **S-105- Computer Fundamental & 'C' Language**

Credits Point**: 4**

L	T	P
3	1	0

Unit	Contents	Contact Hours
I	Number System, Boolean algebra, Basic concept of computer Organization Flow Chart, Algorithm, Basics of Operating System (DOS, Windows, UNIX). 'C' Language: Introduction to algorithms, Flow Charts, Tracing Flow Charts, Problem solving method need for computer language. Reading programs written in C language. C character set, Identifies and Keywords.	**14**
II	Data types, Declarations, Expression, Statement and Symbolic Constants, Input-Output: getchar, putchar, scanf, printf, gets, puts, functions, Pre-Processor Command: # include. main. preparing and running a C program.	**14**
III	Operators & Expressions: Arithmetic. Unary and Logical, Bitwise, Assignment and Conditional operator, Library functions. Control statements. While, Do-While, For Statement, Nested loops. if else, switch, Multi Dimensional Arrays, Structure, Pointers: Declaration, Passing to a function, Operation's on pointers, Data & Files.	**14**

References:

1. Computer Fundamental by D.P. Nagpal
2. Programming in 'C' by R. Hutchison
3. Computer Programming in 'C' by V. Rajaram

Paper Code & Title: **S-201- Statistical Inference**

Credits Point**: 4**

L	T	P
3	1	0

Unit	Contents	Contact Hours
I	Parameter and Statistics. Estimator and Estimate, Criteria for a good Estimator, Consistency. Sufficency condition for Consistency, Properties of Consistent Estimator and problem based or consistency, Unbiasedness, Minimum Variance Unbiased Estimator (MVUE), Efficiencg Theorem on MVU estimator, Cramer Rao's Inequality, Condition for equality C-R	**14**
II	Minimum variance Bound Estimator (MVB Estimator) and problem based on C-R inequali4j, Sufficiency - Fisher's Neyman Theorem, Factorization Theorem and problem on Sufficiency Completeness, Complete Sufficient Statistics, Rao-Blackwell Theorem, Lehman Scefret6 theorem, Problem based on Compete ness, Method of Estimation, Method of Maximum Likelihood(MLE), Properties of Maximum Likelihood Estimator and their proof, Methodo,J Moments, Method of Least Square, Method of Minimum Chi-Square and Modified Chi-Squ?re., Interval Estimation. Confidence Interval and Confidence Coefficient.	**14**
III	Testing Of Hypothesis. Sample and Composite Hypothesis, Critical Region, Two- kinds of error, Type I error and type!, error, Probability of type I error and Type II error, Power of a Test, Most Powerful critical region or Best Critical Region (B.C.R.), Uniformly Most Powerful critical Region (U.M.P. 1. Neymccri Pearson Lemma, Unbiased Test, Uniformly Most Powerful Unbiased Test (U.M.P.U)	**14**

References:

1. Goon Gupta & Das Gupta : An Outline of Statistical Theory Vol. – II
2. Hogg & Craig : Introduction to Mathematical Statistics
3. Kendall & Stuart : Advance Theory of Statistics Vol. – II
4. Wilks, S.S. : Mathematical Stastistics
5. Cramer II : Mathematical Statistics
6. Lehman : Testing of Statistical Hypothesis

Paper Code & Title: **S-202- Sampling Technique**

Credits Point**: 4**

L	**T**	**P**
3	**1**	**0**

Unit	**Contents**	**Contact Hours**
I	'Distinction between census and sample survey, Advantage of sampling methods, Role of sampling theory, Probability sampling. Bias and its effects, sample frame and sampling fraction. Sampling and non-sampling errors. Sampling random sampling with and without replacement technique of selection a sample random sample, Notation and terminology, Estimation of population total and population Mean, Variance and standard error of the estimation.	**14**
II	Stratified Sampling: Introduction. Definition of strata. Principal of Stratification, and uses of Stratified Sampling, Stratified Random Sampling. Notation and Terminology. Estimation of population total population mean. Variance and standard error of the estimation,. Allocation of sampling size. (a) Equal allocation (b) Proportion allocation (c) Nernan allocation or optimization allocation Variance of the estimation for the above cases. Systematic Sampling: Introduction and definition. Estimation of population total and population mean, Variance and standard error of the estimates. Comparison of systematic sampling and simple random sampling without replacement (SRSWOR), Systematic sampling vs. Stratified sampling.	**14**
III	Ratio Method of Estimation : Ratio estimate, Expected value of the ratio estimate, First and Second approximation to the expected value of the estimate, Variance of the Ratio Estimate, An optimum property of the Ratio Estimate, Efficiency of the Ratio Estimate, Ratio Estimate in Stratified sampling, The two-phase or double sampling, Sampling with varying probabilities -Ratio Estimate and its variance. Regression Method of Estimation : Simple Regression Estimation, Expected Value of the Regression estimate, Variance of the Simple Regression Estimate, Conditions Under which the Simple Regression Estimate is Optimum, Comparison of Simple Regression Estimate with Ratio Estimate and the Simple Unbiased Estimate, Comparison of Simple Regression Estimate with Stratified Sampling, Double Sampling, Cluster Sampling, Efficiency of Cluster Sampling, Efficiency of Cluster Sampling in terms of Intra Class Correlation Equal Cluster and Unequal cluster, Sub - Sampling and Two - Stage Sampling.	**14**

Paper Code & Title: **S-203- Computer Oriented Numerical Analysis**

Credits Point**: 4**

L	**T**	**P**
3	**1**	**0**

Unit	**Contents**	**Contact Hours**
I	Computer of Algebraic and Transcendental Equation: Bisection Method. Iterative method Method of False Position, Netwon Raphson Method. Secant Method and their Rate of Convergence. Muller Method. Giraffe's Root Squaring Method. Lin- Baristow's Method. Program Algorithms for False Position. Secant, Bisection, Newton Raphson Methods. Interpolation: Finite difference. Forward backward and Central difference, Symbolic relation and separation of symbols. Factorial notations differences of a Polynomials, Newton formulae for interpolation, Central difference formulae, Stiriling's formula, Bessel's Hermite's formula, Interpolation with Cubic Splines Derivation of the governing equations and condiations. Programs and Algorithms for Lagranges Method. Newton Interpolation.	**14**
II	Curve Fitting: Least Square curve fitting a straight. Nonlinear curve fitting, Approximation of functions, Chebyshev Polynomials, Economization of Power Series, Linear Difference equation Homogenous linear equation with constant coefficient. Programs and algorithms for Least Square method. Numerical Integration: Maximum & Minimum values of tabulated functions. Trapezoidal rule, Simpsons 1/3, 3/8 Rule. Weddle's rule. Newton Cotes Integration formulae. Legendre formulae. Lobatto Integration method. Programs and algorithms for Trapezoidal rule, Simpsons rule.	**14**
III	Numerical Solution of Ordinary Differential Equations: Solution by Taylor's series, Picard's method, Euler's method. Modified Eluer's method, Runge method, Runge-Kutta Forth order method. Predictor Corrector method. Milliness method finite difference method Simultaneous & Higher Order equation. Programs and algorithms Picard's method. Euler's method, Modified Euler's method, Runge method Runge-Kutta fourth order method.	**14**

References:

1. Numerical Analysis by S.S. Sastry
2. Numerical Method by Iyenger Jain
3. Computer Oriented Numerical Method by Balguruswamy

Paper Code & Title: **S-204- Design of Experiments & Linear Estimation**

Credits Point**: 4**

L	T	P
3	1	0

Unit	Contents	Contact Hours
I	Linear models of full rank and not full rank. Estimable functions, Least square and Generalized Least square Method of Estimation, Gauss Markoff Theorem, Analysis of variable in One — Way and Two — Way classification with one observations as well as equal observations in each cell.	**14**
II	Design of experiments, Principals of design of Experiments, Randomisation, Replication, Local Control, Completely Randomised Design (CRD), Randomised Block Design (RBD), Latin Square Design (LSD).	**14**
III	Missing Plot Analysis, Balanced Incomplete Block Design (BIBD), Relationship between parameter of BIBD, Efficiency of BIBD with respect to RBD, Factorial Design 2^3 and 2^n factorial Design of Experiment, Confounding: Partial Confounding in 2^3 factorial Experiment (only), Analysis of Co-variance with one concomitant variable and analysis of co- variance in RBD. Split Plot Design.	**14**

References:

1. Das & Giri: Design, Analysis of Experiments
2. Goon. Gupta & Das Gupta: Fundamental of Statistics, Vol. II
3. Fisher: Design of Experiments
4. Goon, Gupta & Das Gupta: An Outline of Statistical Theory Vol. II
5. Cochran & Cox: Experimental Designing
6. Sceffe's: Analysis of Variance
7. Fefferer: Experimental Design Theory analysis

Paper Code & Title: **S-205- Industrial Statistics**

Credits Point**: 4**

L	**T**	**P**
3	**1**	**0**

Unit	**Contents**	**Contact Hours**
I	Time series and its Components. Secular trend. Seasonal Variation, Cyclic Variation and irregular Variation & measurement of trend, method of Semi-moving average, Method of Curve Fitting by Least Square Principal, Fitting of Straight line Second Degree Polynomial, Experiment Curve.	**14**
II	Statistical Quality Control- process and Product Control chart for mean. Range, Standard deviation. Fraction Defective and Number of Defects.	**14**
III	Single Sampling Plan. Double Sampling Plan. SPRT, OC function of SPRT and ASN of Sequential Sampling Plan. Index Number — Introduction	**14**

References:

1. Goon Gupta & Das Gupta: Fundamental of statistics. Vol. II
2. Gupta. S. C. & Kapoor, V .K.: Applied Statistics

Paper Code & Title: **S-301- Advance Statistical Inference**

Credits Point**: 4**

L	T	P
3	1	0

Unit	Contents	Contact Hours
I	Testing of Hypothesis: Test of Statistical Hypothesis Critical region. Error of type I and Type Level of significance. Optimum tests in different situations. MP and UMP critical regions, Unbiased Test, UPM critical region. MP and UPM regions in a random sampling from a Normal Distribution. Type A regions and Type A_l regions . Optimum regions and Sufficient Statistics, Randomized test. Composite Hypothesis and similar regions. Similar regions and complete sufficient statistics, Construction of most powerful similar regions. Test for the mean of a normal distribution, Test for the variance of a normal distribution. Monotonicity of power functions, Consistency. Invariance, Likelihood — Ratio Test.	**14**
II	Sequential Analysis: Two aspects of a Sequential procedure. Sequential testing OT Hypothesis, Wald's SPRT, determination of A and B. Some results about the Sample Number n, OC function of SPRT test for a Composite Hypothesis. Sequential estimation, Stein's — two stage sampling. Non — parametric Inference: Chi-square test of goodness of fit, Kolmogorov — Smirnov one sample test, Comparison of $x,^2$ — test and KS test, one sample and paired sample problems, The ordinary sign test, The Wilcoxon signed rank test. Wilcoxon paired sample signed rank test, Comparison of the sign test and Wilcoxon paried sample signed rank test, Two sample problems, Wald — Walfowitz run test. Wolmogorov — Simirnov two sample tests. Mann - Whitney U test. Rank tests. Rank test for location. Rank test for dispersion. The Co-sample problem, Distribution free confidence intervals and tolerance interval.	**14**
III	Elements of Decision Theory: Some basics concepts. Decision space. Decision function or decision rule, Admissibility. Minimax approach and Baye's approach, Structure of Baye's rule, Complete class of rules. construction of minimax rules. Least favorable rules, point estimation as a decision problem, Quadratic loss function. Squared — error loss function, Absolute error function Hypothesis testing as a decision problem, Interval estimation as decision problem. Confidence Interval and Confidence Coefficient. A simple method of obtaining confidence limits Confidence belt, A more general method of obtaining confidence limits, Shortest confidence intervals, Theory of confidence sets.	**14**

References:

1. Out Line of Statistical Theory — Goon , Das & Gupta
2. Mathematical Statistics — S.C. Gupta & V.K. Kapoor.

Paper Code & Title: **S-302- Operation Research**

Credits Point**: 4**

L	**T**	**P**
3	**1**	**0**

Unit	**Contents**	**Contact Hours**
I	Definition & Scope of Operation Research. Different types of models & their constriction. Linear Programming: Convex Sets. Graphical method. Simplex method, Revised Simplex method,	**14**
II	Duality theory, Dual Simplex method, Sensitivity analysis, Multi objective & Goal Programming, Solutions user graphical & Simplex method.	**14**
III	Integer Programming: Cutting plan, Branch & Bound techniques for all integer, or mixed programming Algorithms for 0 — 1, Traveling alesman & Cargo loading problems. Transportation Problem: Processing of jobs thought machines. CPM & PERT.	**14**

References:

1. Operations Research — S.D.Sharma
2. Operations Research — J.K.Sharma
3. Operations Research_ Ravindran, Phillips Adberg
4. Introduction of Operations Research — F.S.Hiller & G.J.Liberman
5. Operations Research - H.A.Taha

Paper Code & Title: **S-303- Stochastic Process**

Credits Point**: 4**

L	T	P
3	1	0

Unit	Contents	Contact Hours
I	Introduction to stochastic processes: Classification of according to state space and time domain, Countable state Markov chains, Chapman-Kolmogorov equations; calculation of n-step transition probability and its limit, Stationary distribution, classification of states of Markov chains.	**14**
II	Discrete state space continuous time MC: Kolmogorov–Feller differential equations, Poisson process, birth process, Death process, birth and death process. Random walk and gambler's ruin problem. Wiener process as a limit of random walk, Differential equation and first passage time distribution. Renewal theory: Renewal function, renewal equation, Elementary renewal theorem and applications, Statement and uses of key renewal theorem, study of residual life time to a fixed point.	**14**
III	Branching process: Galton-Watson branching process, probability of ultimate extinction, distribution of total number of progeny, Martingale in discrete time queueing theory: queueing models, differential equation of distribution of birth –death process, M/M/1 queue, M/M/s queue.	**14**

References:

1. Adke, S. R. and Manjunath, S. M. (1984): An Introduction to Finite Markov Processes, Willey Eastern.
2. Bharat, B. R. (2000): Stochastic Models: Analysis and Applications, New Age International, India.
3. Cinlar, E. (1975): Introduction to Stochastic Processes, Prentice Hall.
4. Feller, W. (1968): Introduction to Probability and its Applications, Vol. 1, Wiley Eastern.
5. Harris, T. E. (1963): The Theory of Branching Processes, Springer-Verlag.
6. Hoel, P. G., Port, S. C. and Stone, C. J. (1972): Introduction to Stochastic Processes,Houghton Miffin & Co.
7. Jagers, P. (1974): Branching Processes with Biological Applications, Wiley.
8. Karlin, S. and Taylor, H. M. (1975): A First Course in Stochastic Processes, Vol. 1, Academic Press.
9. Medhi, J. (1982): Stochastic Processes, Wiley Eastern.
10. Parzen, E. (1962): Stochastic Processes, Holden-Day.
11. Srinivasan, S. K. and Mehata, K. M.: Stochastic processes

Paper Code & Title: **S-304- Econometrics and Demand Analysis**

Credits Point**: 4**

L	T	P
3	1	0

Unit	Contents	Contact Hours
I	Nature of econometrics, Linear regression model, assumptions, estimation of parameters by least squares and maximum likelihood methods, test of hypothesis and confidence estimation for regression coefficients, R^2 and adjusted R^2 , Use of extraneous information in terms of exact and stochastic linear restrictions, restricted restriction and mixed regression methods and their properties, point and interval predictors.	**14**
II	Tests for structural change, use of dummy variables, problem of multicollinearity, consequences and solutions, estimation of parameters by Generalized least squares in models with non spherical disturbances Hetroscedasticity of disturbances, estimation under hetroscedasticity and test for hetroscedasticity.	**14**
III	Autocorrelation, Durban- Watson test, Estimation under auto-correlated disturbances Errors in variables model, inconsistency of least squares method Instrumental variable method. Demand and Supply curve, price-elasticity of demand, partial elasticity of demand.	**14**

References:

1. Apte P. G. (1990); Text book of Econometrics. Tata McGraw Hill
2. Cramer, J. S. (1971): Empirical Econometrics, North Holland.
3. Gujarathi, D. (1979): Basic Econometrics, McGraw Hill.
4. Intrulligator, M. D. (1980): Econometric models - Techniques and applications, Prentice Hall of India.
5. Johnston, J. (1984): Econometric methods, Third edition, McGraw Hill.
6. Klein, L. R. (1962): An introduction to Econometrics, Prentice Hall of India.
7. Koutsoyiannis, A. (1979): Theory of Econometrics, Macmillan Press.
8. Malinvaud, E (1966): Statistical methods of Econometrics, North Holland.
9. Srivastava, V. K and Giles D. A. E. (1987): Seemingly unrelated regression equations models, Maicel Dekker.
10. Theil, H. (1982): Introduction to the theory and practice of Econometrics, John Wiley.
11. Walters, A (1970): An introduction to Econometrics, McMillan & Co.
12. Wetherill, G. B. (1986): Regression analysis with applications, Chapman Hall.
13. Gupta S C & Kapoor V K; Applied Statistics.

Paper Code & Title: **S-401- Multivariate Analysis**

Credits Point**: 4**

L	**T**	**P**
3	**1**	**0**

Unit	**Contents**	**Contact Hours**
I	Multivariate Normal Distribution (MND), Characteristic function of MND. Marginal and Conditional Distribution, Estimation of Mean Vector and Covariance Matrix, Partial and Multiple Correlation Coefficient and Their Estimation in a Sample from Multivariate Normal Distribution.	**14**
II	Wishart Distribution and its reproductive property and their properties. Concept of generalized variance.	**14**
III	Hotelling's T^2-Distribution, Motivation and Derivation and its optimum properties, Mohalanobis. D^2 -tests of independence, Wilk's Criterion.	**14**

References:

1. Anderson, T.W.: An Introduction to Multivariate Statistical Analysis and Edition (Wliey Sries in Probability & Mathematical Statistics)
2. Kshiusagar, A.M.: Multivariate Analysis (Matcell Dokker INC. New York)
3. Kahtri. C.G.: Multivariate Analysis
4. Dillon. W.R. & Goldstein, M.: Multivariate Analysis Method and its Application (Wiley Series in Probability & Mathematical Statistics).

Paper Code & Title: **S-402- Biostatistics & survival Analysis**

Credits Point**: 4**

L	T	P
3	1	0

Unit	Contents	Contact Hours
I	Techniques of Demography Analysis- Mortality Indices of mortality measure, Crude Death Rate, Age-Specific death rate, Infant Mortality Rate, Neonatal and Prenatal mortality rate, Standardization of Mortality Rate, Direct method and Indirect method of Standardization, Life table, Relationship between life table function, relationship between q_x & M_x relationship between q_x & μ_{x_1} relationship between m_x & μ_x relationship between ϵ_x^0 & ϵ_{x+1}^0, Relationship between μ_x & ϵ_x^0 Relationship between complete and curtailed expectation of life. Abridged life table, Greville's formula between abridged life table function ${}_nm_x$ & ${}_nq_x$, Greville's formula for construction of an abridged life table, Reed and merrelle's formula problem of construction of abridged life table. King's method of construction of a Abridged Life table, Sampling distribution of life table function, Estimation of survival probability p_j by the method of maximum likelihood.	**14**
II	Techniques of Demographic Analysis Fertility, Indices of Fertility measures, CBR, GFR, Age-Specific Fertility Rate TFR, GRR & NRR, Relationship between Crude Birth Rate (CBR), General Fertility Rate (GFR) and Total Fertility Rate (TFR) Competing Risk Theory, measurement of competing risks, Hazard rate, crude probability ($Q_{i\delta}$), Net probability type A ($q_{i\delta}$), Net probability type B ($q_{i.\delta}$), Partial Crude Probability ($Q_{i\delta.\varepsilon}$)$\delta\neq\varepsilon$, Inter-relation of the probabilities $Q_{i\delta}$, $q_{i\delta}$, $q_{i.\delta}$,$Q_{i\delta.\varepsilon}$ Relationship between crude probability and Net-probability type-A, Relationship between Net probability type-B ($q_{i.\delta}$) and crude probability ($Q_{i\delta}$), Relationship between partially Crude probability($Q_{i\delta.\varepsilon}$) and crude probability, Estimation of crude, Net and partially crude probability Neyman's modified X^2-method, Estimation of partially crude probability (Qiδ.ε).	**14**
III	Concept of time, order and random censoring, likelihood in the distributions – exponential, gamma, Weibull, lognormal and Pareto distributions. Life tables, failure rate, mean residual life and their elementary properties, Ageing classes and their properties, Bathtub failure rate. Estimation of survival function – actuarial estimator, Kaplan – Meier estimator, estimation under the assumption of IFR/DFR, Comparison between parametric and non-parametric estimates, Total time on test. Two sample problem –log rank test and Gehan test. Semi-parametric regression for failure rate – Cox's proportional hazards model with one and several covariates, Likelihood Ratio (LR) test for the regression coefficient	**14**

Paper Code & Title: **S-403- Advanced Design of Experiment**

Credits Point**: 4**

L	T	P
3	**1**	**0**

Unit	Contents	Contact Hours
I	Partially balanced incomplete block designs. Resolvable and affine resolvable designs. Dual and linked block designs. Lattice Designs. Construction of PBIB designs. Cross-over designs. General	**14**
II	Theory of Fractional Factorial Experiments. Optimal designs- Various optimality criteria. Symmetric and asymmetric orthogonal arrays and their constructions.	**14**
III	Robust Parameter designs. Response surface designs- orthogonality, rotatability and blocking. Weighing designs. Mixture Experiments.	**14**

References:

1. Chakrabarti, M.C. (1962). Mathematics of Design and Analysis of experiments, Asia Publishing House.
2. Cornell, John A. (2002). Experiments with Mixtures, John Wiley & Sons.
3. Das, M. N. and Giri, N. C. (1986). Design and Analysis of Experiments, Wiley Eastern Limited.
4. Dey, A. (1986). Theory of Block Designs, John Wiley & Sons.
5. Dey, A. and Mukerjee, R. (1999). Fractional Factorial Plans, John Wiley & Sons.
6. Hedayat, A. S., Sloane, N. J.A. and Stufken, J. (1999). Orthogonal Arrays: Theory and Applications, Springer.
7. Hinkelmann, K. and Kempthorne, O. (2005). Design and Analysis of Experiments, Vol. 2: Advanced Experimental Design, John Wiley & Sons.
8. Jones, B. and Kenward, M.G. (2003). Design and Analysis of Cross-over Trials. Chapman & Hall/CRC Press.
9. Montgomery, D. C. (2005). Design and Analysis of Experiments, Sixth Edition, John Wiley & Sons.
10. Myers, R. H. and Montgomery, D. C. (2002). Response Surface Methodology: Process and Product Optimization using Designed Experiments, John Wiley & Sons.
11. Raghavarao, D. (1970). Construction and Combinatorial Problems in Design of Experiments, John Wiley & Sons.
12. Wu, C. F. J. and Hamada, M. (2000). Experiments: Planning, Analysis and Parameter Design Optimization, John Wiley & Sons.

Paper Code & Title: **S-404- Bayesian Inference**

Credits Point**: 4**

L	T	P
3	1	0

Unit	Contents	Contact Hours
I	Subjective interpretation of probability in terms of fair odds, Bayes theorem and computation of the posterior distribution, Natural conjugate family of priors, Hyper parameters of a prior from conjugate family, Conjugate family for (i) exponential family models (ii) models admitting sufficient statistics for fixed dimension, Non informative, improper and invariant priors. Jeffery's prior.	**14**
II	Bayesian decision theory: Bayes solutions for practical decision problems, Bayesian point estimation as a prediction problem from posterior distribution, Bayes estimators for (i) absolute error loss (ii) squared error loss (iii) 0 -1 loss. Generalization to convex loss functions, Evaluation of the estimates in the terms of the posterior risks.	**14**
III	Bayesian interval estimation: credible intervals, highest posterior density regions, Interpretation of the confidence coefficient of an interval and its comparison with the interpretation of the confidence coefficient for a classical confidence interval. Bayesian testing Hypothesis : Specification of the appropriate from of the prior distribution for a Bayesian testing of hypothesis problem, Prior odds, Posterior odds, Bayes factor for various types of testing problems depending upon weather the null hypothesis and alternative hypothesis are simple or composite, Specification of the Bayes test in above cases, Discussion of Lindley's paradox for testing a point hypothesis for normal mean against the two sided alternative hypothesis.	**14**

References:

1. Berger, J. O.: Statistical Decision Theory and Bayesian Analysis, Springer Verlag.
2. Robert, C. P. and Casella, G.: Monte Carlo Statistical Methods, Springer Verlag.
3. Leonard, T. and Hsu, J. S. J.: Bayesian Methods, Cambridge University Press.
4. Bernando, J. M. and Smith, A. F. M.: Bayesian Theory, John Wiley and Sons.
5. Robert, C. P.: The Bayesian Choice: A Decision Theoretic Motivation, Springer.
6. Gemerman, D.: Markov Chain Monte Carlo: Stochastic Simulation for Bayesian Inference, Chapman Hall.
7. Box, G. P. and Tiao, G. C.: Bayesian Inference in Statistical Analysis, Addison-Wesley.